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Mosquito News

Published Quarterly
by the
AMERICAN MOSQUITO CONTROL ASSOCIATION

VOLUME 7 SEPTEMBER, 1947 NUMBER 3

ENTOMOLOGY LIBRARY
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CONTENTS

ARTICLES PAGE

Airplane Spraying with DDT for Control of Salt-Marsh Mosquito Larvae. C. B. Wisecup, W. C. White and V. S. Minnich 103

Effectiveness of Disinsectization of Aircraft and Ships in the South Pacific (New Hebrides-Solomon Islands) ..... W. J. Perry 108

Mosquitoes Collected in Dakar, French West Africa, Incidental to Army Malaria Surveys. Leo Kartman, Eldon H. Newcomb, E. J. Campau and Fred D. Morrison 110

NEWS AND NOTES 116

EDITORIAL SECTION

The A.M.C.A. Good Neighbor Club ..... H. H. Stage 121

REVIEWS AND ABSTRACTS

DDT and Its Application in Veterinary Medicine. By C. R. Twinn ..... B. V. Travis 122

El DDT y Su Applicación a la Medicina Veterinaria. Por C. R. Twinn. (Translation of a review in English.) 122

Observations on the Night-Time Resting and Biting Habits of Anopheles Mosquitoes in DDT Treated and Untreated Buildings. By Clarence M. Tarzwell and Frank W. Fisk ..... C. M. Tarzwell 123

Control of Anopheline Mosquito Larvae by Use of DDT-Oil Mists. By F. F. Ferguson, E. H. Arnold and Wm. M. Upholt ..... C. M. T. 123

Comparative Studies of DDT Dusts, DDT-Oil Sprays and Paris-Green Dusts Used Routinely in Anopheline Larva Control. By W. V. Mathis, F. F. Ferguson and S. W. Simmons ..... W. V. Mathis 123

The Control of Rat Ectoparasites with DDT. By Russell G. Ludwig and H. Page Nicholson ..... C. M. T. 124

The Control of House Flies by DDT Sprays. By W. C. Baker, H. I. Scudder and E. L. Guy ..... W. C. Baker 124

Extended Laboratory Investigations of the Toxicity of DDT Residues to Adults of *Anopheles quadrimaculatus*. By R. W. Fay, S. W. Simmons and J. M. Clapp ..... R. W. Fay 124

Notes on the Anophelines of Venezuela and Their Identification. By Pablo Cova Garcia ..... Alan Stone 124

Notas Sobre los Anofelinos de Venezuela y Su Identificación. Por Pablo Cova Garcia. (Translation of a review in English.) 125

A Study of the Migratory Habits of Salt-Marsh and Anopheline Mosquitoes. By Frank Brescia, Irwin D. Wilson, John Rowell and Kenneth C. Hodges ..... Leo Kartman 125

Biological Characteristics of Laboratory-Reared *Aedes atropalpus*. By H. L. Trembley ..... Author's abstract 126

Resistance of Mosquito Larvae and Pupae to Experimental Drought. George H. Bick and George H. Penn. ..... L. K. 126

Resistancia de Larvas y Ninfas de Mosquitos a la Sequía Experimental. Por George H. Bick y George H. Penn. (Translation of a review in English.) 127

GENERAL BIBLIOGRAPHY 129

LIST OF ADVERTISERS 120

ADVERTISING RATES 128

MOSQUITO NEWS

Official Organ of the American Mosquito Control Association

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Published by
AMERICAN MOSQUITO CONTROL ASSOCIATION

Printed by
Boyd Printing Company, Inc., Albany, N. Y.

A quarterly journal published on the 20th of March, June, September and December. Devoted to the improvement and the sound extension of mosquito control and related work as a vital public service.

SUBSCRIPTION RATES

$3.00 per Year (U. S. money), Single Copies, 75 cents.
Mailed without charge to members of the Association.

MEMBERSHIP DUES

Associate Members $2.50
Active Members 4.00

BUSINESS COMMUNICATIONS

Communications relating to editorial matters and manuscripts submitted for publication in Mosquito News should be addressed to Boyd Printing Co., 374 Broadway, Albany 7, N. Y., or to Dr. Robert D. Glasgow, Editor, Mosquito News, New York State Museum, Albany, New York.

Communications relating to advertising space should be addressed to C. T. Williamson, Business Manager, Mosquito News, c/o Suffolk County Mosquito Extermination Commission, Yaphank, New York.

Communications relating to subscriptions to Mosquito News, Membership in the American Mosquito Control Association, and other association matters should be addressed to Thomas D. Mulhern, Secretary-Treasurer, American Mosquito Control Association, New Brunswick, New Jersey.

Application for entry as second class matter at the Post Office at Albany, N. Y., pending.

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ARTICLES

AIRPLANE SPRAYING WITH DDT FOR CONTROL OF SALT-MARSH MOSQUITO LARVAE[1]

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AND

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Enormous broods of the salt-marsh mosquitoes *Aedes sollicitans* (Walk.) and *A. taeniorhynchus* (Wied.) are produced each summer on the marshes just back of the outer protecting sand dunes along the coast of the Southeastern States. The Florida east coast between St. Augustine and Fort Pierce contains typical areas of marsh and was selected for experimental study in 1945. These marshes are covered primarily with pickleweed *(Saltwort)* and spike-grass *(Juncus)*, although some areas are heavily matted with salt grass *(Distichlis)* and black mangrove. The areas of mangrove are limited to the slightly higher edges of the marsh, and in this locality the tree is low-growing and bushy. Extensive series of ditches have been constructed to drain the water from the worst of the known breeding areas, especially within 10 miles of large towns.

As is the case with other species of mosquitoes that breed in floodwater, the stimulus for the hatching of salt-marsh mosquito eggs is flooding and attendant favorable temperatures. Owing to the sanding up of inlets in this area, the marshes are only slightly affected by tidewater, the principal cause of flooding being the seasonal rains from June through September. Extremely high tides combined with heavy rains occasionally induce breeding in unexpected places. Such situations call for the development of control measures which can be quickly applied to large areas.

Soon after DDT had been found to be an excellent mosquito larvicide (Deonier *et al.* 1945b), and spraying techniques for airplane application had been devised (Deonier and Burrell 1945a, Wisecup *et al.* 1945a), an attempt was made to develop procedures and dosages for abating the nuisance of salt-marsh mosquitoes by controlling the larvae in the breeding areas. Previous work had shown that adults of these species could be reduced by spraying DDT from an airplane (Lindquist *et al.* 1945), but such treatment, while spectacular and undoubtedly effective, required the spraying of many square miles of territory to control the adults which had emerged from a much smaller acreage of breeding area.

Two series of tests utilizing airplane application of sprays were conducted during the spring and summer. In the first series an attempt was made to secure control with applications made before flooding and hatching, and in the second series with direct larvicidal applications to typical marsh areas in which active breeding was occurring.

PREFLOODING APPLICATIONS

The success of preflooding applications of DDT sprays for the control of floodwater species of the *Psorophora* group had been demonstrated in 1944 (Wisecup and Deonier 1945b; Wisecup *et al.* 1945a).

[1] This work was conducted under a transfer of funds, recommended by the Committee on Medical Research, from the Office of Scientific Research and Development to the Bureau of Entomology and Plant Quarantine.

[2] Now with the Office of the Engineer, U. S. Army.

Similar treatments with 5 and 10 per cent of DDT were made at monthly intervals to a group of marshy islands in the Mosquito Lagoon south of New Smyrna, Fla., from April to June, 1945. These applications were made from a helicopter (HNS–1)[3] and an L–4 (Piper Cub) plane. It was hoped that sufficient DDT would be deposited to act as a larvicidal agent when flooding and subsequent hatching did occur.

Occasional sets of sod samples were taken at random from the treated islands and tested against laboratory-reared larvae of *Aedes aegypti* (L.), with the results shown in Table 1. Only limited breeding occurred on these islands during the initial flooding of late June; therefore, no data were obtained on the effectiveness of the treatments against salt-marsh mosquito larvae. Later flooding in August produced a tremendous crop of mosquitoes on all treated areas. It would appear that, under the Florida coastal conditions of intense sunlight and high humidity with heavy dews, the value of a DDT spray applied as a preflooding treatment is probably limited to a month.

TABLE 1. Toxicity to mosquitoes of DDT sprays applied by airplane to marshy islands before flooding occurred.

Date treated	Concentration of DDT	Type of spray	Dosage of DDT	Mortality of *Aedes aegypti* exposed to sod samples taken on—		
				May 17	May 29	June 13
	Per cent		*Pounds per acre*	*Per cent*	*Per cent*	*Per cent*
		Helicopter				
April 13	5	Fuel-oil solution	0.2	90	5	2
	5	Aqueous emulsion	.2	70	10	10
		Piper Cub				
May 8	5	Fuel-oil solution	.2	100	..	5
		Aqueous emulsion	.2	85	..	2
22	10	Fuel-oil solution	.4	..	75	0
		Aqueous emulsion	.4	..	60	5
			.8	..	100	45
		Check (untreated)		0	0	0

DIRECT LARVICIDAL APPLICATIONS

DDT larvicides were applied at the beginning of the rainy season, late in June, and thereafter with each brood of mosquitoes. Applications were made from a Stearman PT–17 biplane and an L–4 plane, both equipped with a supply tank, a wind-driven propeller pump, and outlet bars beneath the wings which were provided with either 60- or 70-gage outlet orifices. All applications were made by flying just above the low-growing vegetation.

The treatments used and the results obtained are presented in Table 2. The degree of control varied from perfect (no surviving larvae) to as low as 80 per cent when both oil solutions and water emulsions were used. It was apparent that 0.2 pound of DDT per acre was a minimum effective dosage, and that the type and amount of vegetation and the weather were important factors in determining the control obtained.

[3] This spraying was conducted on a cooperative basis by the Navy, the Coast Guard, and the Bureau of Entomology and Plant Quarantine.

TABLE 2. Control of salt-marsh mosquito larvae with DDT sprays applied by airplane, 1945.

Date treated	Concentration of DDT	Type of spray	Dosage of DDT	Area treated	Weather conditions	Average larvae before treatment	Control	Remarks
	Per cent		*Pounds per acre*	*Acres*		*Number*	*Per cent*	
		Stearman (PT-17) airplane equipped with breaker bars and spray booms having 70-gage orifices						
June 27	5	Fuel-oil solution	0.2	90	Hot, strong breeze	25	None	Equipment clogged
Aug. 31	5	Aqueous emulsion	.2	30	Warm, slight breeze	3	99.9	Open marsh, light vegetation
		80–20 fuel-lube oil solution	.2	30	Warm, slight breeze	3	98.4	
		Stearman (PT-17) airplane equipped with spray booms (no breaker bars) having 60-gage orifices						
Sept. 11	10	Aqueous emulsion	.8	15	Cool, slight drizzle	35	90	Application made after pupation had commenced
19	5	80–20 fuel-lube oil solution	.2	60	Warm, fair breeze	15	95	Series of open pools among sand dunes; poor drift of spray
19	10	Aqueous emulsion	.4	60	Warm, fair breeze	50	100	Perfect control in grassy sloughs
		Piper Cub (L-4) airplane equipped with breaker bars and spray booms having 60-gage orifices						
July 14	5	Fuel-oil solution	.2 [1]	10	Warm, little breeze	50	80	Perfect control in open water, none in areas of heavy vegetation
		Aqueous emulsion	.2 [1]	5	Warm, little breeze	100	80	
Aug. 11	5	Fuel-oil solution	.4 [2]	25	Cool, cloudy, slight breeze	15	99.8	Perfect control, except in one area of tall spike grass
29	5	Aqueous emulsion	.4 [2]	15	Cool, cloudy, fair breeze	100	100	¼ inch rain within an hour washed all residue into water
	10	Aqueous emulsion	.4 [1]	30	Cool, cloudy, fair breeze	15	100	¼ inch rain within an hour washed all residue into water
	5	80–20 fuel-lube oil solution	.4 [2]	15	Cool, cloudy, fair breeze	31	100	
	10	80–20 fuel-lube oil solution	.4 [1]	30	Cool, cloudy, fair breeze	50	100	

[1] 80-foot swath width.
[2] 40-foot swath width.

The spray booms initially designed for the Stearman (PT–17) airplane had outlets of only 70-gage size. This equipment delivered a spray in which nearly 65 per cent of the droplets had a diameter of less than 100 microns. This spray drifted widely and settled poorly under unfavorable weather conditions. The first larvicidal test with this equipment on June 27 was unsuccessful because the orifices became clogged. Tests with the equipment working properly on August 31 gave nearly perfect control.

When the size of the outlet orifices was changed to 60 gage and the impinging bars were removed, the droplets were larger and tended to fall in a more even swath. The application with this equipment on September 11 was made after pupation had commenced, and despite the heavy dosage a fair brood of adults emerged. The tests of September 19 were conducted on areas which were not typical open marshes. The application of 0.4 pound of DDT per acre as a 10-per cent aqueous emulsion gave perfect control in a series of grassy sloughs. Less effective control was obtained with 0.2 pound of DDT per acre as a 5-per cent oil solution over open pools among the seaside dunes, where a high lapse rate (uprising air) and a strong wind resulted in poor deposition.

The Piper Cub, which was equipped with breaker bars and spray booms having 60-gage orifices, produced a spray with a wide range of droplet diameters. This airplane appeared to exert much less downward thrust to the spray than did the Stearman. Unsatisfactory control was secured on July 14 with a solution and an emulsion, each containing 5 per cent of DDT, applied at the rate of 0.2 pound of DDT per acre. The plane was flown over swaths 80 feet wide and the spray did not penetrate the thick vegetation. On August 11 nearly perfect control with the solution was obtained in a marshy area similar to the one treated on July 14 by decreasing the swath width from 80 feet to 40 feet and thus applying 0.4 pound of DDT per acre.

The tests on August 29 were designed to compare the control obtained with solutions and an emulsion applied to swaths 40 and 80 feet wide. A heavy shower immediately after the final treatment washed sufficient material from the vegetative cover into the water to cause complete mortality in all plots. Further replications were prevented by the transfer of this airplane to another project.

Deposition and Penetration Study

A single 15-acre marsh area was treated with 5 per cent of DDT in an oil solution which contained an oil-soluble dye, in order to study the deposition and penetration of the spray. Glass plates and slides coated with magnesium oxide were exposed at 10 random locations, both above and below the vegetative cover. The spraying was done with a Piper Cub airplane calibrated to discharge 4 quarts of oil per acre when flying swaths 40 feet wide. This should have deposited 0.4 pound of DDT per acre. The results were determined by colorimetric analyses of the residues on the plates and by microscopic examination of the slides, and are presented in Table 3. The deposition of DDT on the exposed plates ranged from 0.22 to 0.82 pound, with an average of 0.43 pound, per acre. This variation shows that even with a narrow swath the DDT deposit was very irregular. The amounts of DDT on the hidden plates varied according to the protection they received. The degree of penetration ranged from 2 to 100 per cent, 0.1 pound of DDT per acre being the smallest amount deposited. In general, the proportion of different-sized drops that penetrated the foliage was the same as for those deposited on the exposed plates.

Discussion.—Treatments applied before the flooding of known breeding areas were of no value in the control of *Aedes* larvae during 1945. Such treatments of most marsh areas would be of doubtful value, for the following reasons: (1) The time between treatment and flooding is dependent upon climatic conditions, and

TABLE 3. Deposition and penetration of DDT-oil spray applied to salt-marsh area by airplane

Station	Cover	Location of plates with respect to vegetative cover	Dosage of DDT	Droplets in indicated range		
				10–100 microns	100–220 microns	220+ microns
			Pounds per acre	*Per cent*	*Per cent*	*Per cent*
1	Slight; short grasses	Above	0.44	41	30	29
	Thin stand	Below	.46	36	31	33
2	Fair; short pickleweed	Above	.24	59	37	7
	Thin stand	Below	.12	67	28	5
3	Fair; short pickleweed	Above	.45	37	44	19
	Thin stand of spikegrass	Below	.26	39	41	20
4	Good, short pickleweed	Above	.46	54	21	25
	Thick stand	Below	Spoiled	26	38	36
5	Very good; tall pickleweed	Above	.22	57	38	5
	Thin stand of spikegrass	Below	.03	69	26	5
6	Fair; tall pickleweed	Above	.53	58	33	9
	Thin stand	Below	.12	59	32	9
7	Good; spikegrass	Above	.82	30	42	28
	Compact stand	Below	.11		Spoiled	
8	Fair; short pickleweed	Above	.34	45	36	19
	Medium stand	Below	.23	50	29	21
9	Good; medium pickleweed	Above	.30	49	43	8
	Thick stand	Below	.15	62	10	28
10	Excellent; tall pickleweed	Above	.46	33	32	35
	Tall spikegrass	Below	.01	45	51	4
	Average	Above	.43	46	35	19
		Below	.17	50	32	18

may be several months, (2) the intervening weather is deleterious to the applied spray, and (3) the flooding is frequently so heavy that the toxic residue might be washed away.

There were indications that the sprays were screened out less by low, thick cover than by tall, thin stands of vegetation. Tall growth especially impeded the deposition of drifting spray. There appeared to be less contamination in areas of tall spikegrass than in areas of low growing, relatively dense pickleweed. It is probable that sufficient DDT was deposited to give control of *Aedes* larvae at all stations except numbers 5 and 10.

Summary.—Large-scale applications of DDT sprays from airplanes as preflooding treatments gave no control of salt-marsh mosquito larvae in 1945.

Direct application of DDT sprays by airplanes is a feasible method of controlling salt-marsh mosquito larvae. The treatments must be applied before pupation commences, and sufficient material should be applied so that it penetrates the vegetative cover. A minimum effective dosage was 0.2 pound of DDT per acre. More satisfactory control was secured from the application of 0.4 pound of DDT per acre. At this dosage a sufficient amount of DDT to control *Aedes* larvae penetrated all except the tallest and densest vegetation.

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EFFECTIVENESS OF DISINSECTIZATION OF AIRCRAFT AND SHIPS IN THE SOUTH PACIFIC (NEW HEBRIDES-SOLOMON ISLANDS)[1]

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Little emphasis has been attached to the results obtained by malariologists and entomologists in their effort to prevent the dissemination of mosquitoes from base to base throughout the South Pacific during World War II.

Air and surface traffic brought many of the once distant island bases to within a matter of hours separation. Non-malarious bases became cloaked by the shadow of the anopheline mosquito, and in the minds of many, responsible for the protection of the health of Allied Forces in the Pacific, came visions of added death and great military loss as a result of possible infestation of new areas due to the stepped-up transport system of civilization.

New Caledonia, the Fiji Islands, Samoa, and New Zealand are non-malarious, and particular emphasis was made to keep these bases anopheline free, for they were used by military forces as training areas and as "demalarialization" and rehabilitation centers for troops recently evacuated from combat in malarious zones.

Directives issued by the Commander of the South Pacific Force were the legal basis for enforcement of regulations pertaining to disinsectization of ships and planes. The malariologist or entomologist on duty at non-malarious bases routinely conducted surveys for the possible introduction of anopheline mosquitoes in and about the vicinity of airports and harbors. Aircraft taking off from malarious bases en route to non-malarious bases were sprayed either by crew members themselves or by members of special quarantine units attached to the various squadrons whose sole duty was to carry out an effective spray program. Before landing, these aircraft were again required by direction to have all cabins and compartments sprayed before permission could be granted for landing. Here again, ground crews of the malaria control organization on these non-malarious bases checked as completely as possible the proper fulfillment of these orders.

The author has observed on many occasions the presence of pest mosquitoes and anophelines resting in the cabins of aircraft that had remained open during the night for loading before early morning departures. Thorough spraying of cabins at take-off and landing is the only explanation of the failure of these mosquitoes to be introduced into new areas. Ample opportunities for establishment of mosquitoes in ideal breeding sites were provided at many of the airports on which planes were scheduled to land.

Even though ship inspection afforded

[1] Data collected while serving in the capacity of Area Entomologist, South Pacific Area.

many difficulties and frequent violations in disinfecting surface vessels occurred, the transport of adult mosquitoes between bases was kept at a minimum. Generally, the docking patterns and anchorages of ships and the absence of anopheline breeding near loading areas were compatible with malaria control efforts in accomplishing this. Constant favorable winds also aided greatly in keeping the adults away from the shore line and from blowing across open channels. The flight range of *Anopheles farauti* is limited to about one-half mile, and the consensus among entomologists is that this species does not by preference fly over bodies of water such as the typical inter-island anchorage channels in the Pacific. Evidence of this fact is the large number of small islands nestled within a mile of known highly-malarious islands that have never revealed any anopheline breeding.

Despite the difficulties involved in checking all water containers and in thoroughly spraying compartments on ships docking at non-malarious ports, commendable results were obtained in the fulfillment of an adequate quarantine and inspection system. However, several threats in the form of accidental introduction of mosquitoes presented themselves to survey and control operators on important military bases.

Spray crews boarding incoming ships at Noumea, New Caledonia, discovered hordes of adult *Aedes aegypti* in the holds of a freighter carrying salvaged tire casings to the continental United States. Although New Caledonia has more than its share of this important dengue transmitter, their release and subsequent establsihment in non-*aegypti* areas would have presented an added burden to control operators on bases that were *aegypti* free.

It is not unreasonable to understand the difficulties involved in checking small amounts of water held in several thousand stacked tire casings for the presence of *Aedes aegypti*. These were favorite man-made breeding sites for this domesticated species of mosquito, and the extent of the localized infestation of the island from which the ship sailed was determined by systematic survey. Thus, the presence of *Aedes aegypti* on a base previously known to be *aegypti* free was reported almost simultaneously by island entomologists and by disinsecticide crews separated by several hundred miles. Within six months the localized infestation was completely eliminated, and no *aegypti* were reported from the base as of 1945.

Aedes vigilax breeding in brackish water in tidal pools was discovered on Aeissi Island in the New Hebrides. This anopheline-free island was checked weekly for *Aedes aegypti* by inspection crews, and in the course of survey this localized infestation was reported. The small size of the island and the relatively few tidal pools available for establishment made control and complete eradication a simple matter. Although Daggy reported a single larva of *vigilax* collected in 1943 on Espiritu Santo (New Hebrides), no other specimens were collected until 1945. (The larvae closely resemble *Aedes vexans,* and there is a possibility that a mistake may have been made in the identity of the species.) Ships arriving in the New Hebrides for repair in dry docks could have rapidly transported the hardy species from New Caledonia. *Aedes vigilax,* like our own salt marsh mosquito of the Eastern coast, is one of the most vicious biters on New Caledonia, and sections of the Island are at times plagued by these persistent daytime biters.

No other instances of introduction of mosquitoes to bases with known insect faunas were reported or observed. Much credit is due the untiring efforts of Army and Navy Malaria and Epidemic Disease Control operators in maintaining the balance. Theirs was a job receiving little encouragement from most individuals, but through their efforts the important fact remains that *no anophelines were introduced as late as 1945 to the known non-malarious islands during the military occupation.*

MOSQUITOES COLLECTED IN DAKAR, FRENCH WEST AFRICA, INCIDENTAL TO ARMY MALARIA SURVEYS

LEO KARTMAN,* ELDON H. NEWCOMB, EDWARD J. CAMPAU, AND FRED D. MORRISON [1]

Routine malaria surveys in the Dakar region of Senegal, French West Africa, necessitated the collection of known and potential malaria vectors. The collection of anophelines was also required in certain other investigations such as field trials with insecticides, life-history studies, effects of DDT, and natural filarial index, of which the latter two have thus far been reported (Kartman, 1946; Kartman and de Silveira, 1946).

Culicine species were collected from time to time primarily in response to requests from the U. S. National Museum. The exigencies of routine work and certain other matters precluded a more thorough investigation of the ecological conditions concerning the mosquitoes of the Cape Verde peninsula. Systematic type of observation and collecting could not be accomplished. Since the collections were mainly confined to native villages, and occasionally to the countryside about Dakar, they cannot but represent a limited sample of the culicid fauna affecting the tip of the peninsula and extending not more than a maximum of about twelve miles eastward from Dakar.

The present paper is primarily a list of the mosquitoes collected, together with short qualitative notes regarding the circumstances of collection. The collections were made between February, 1944, and February, 1945, and all final identifications were made by Dr. Alan Stone to whom the writers wish to acknowledge their appreciation of his enthusiastic cooperation. Specimens were deposited in the collections of the U. S. National Museum and the Army Medical School. The taxonomic arrangement is in conformity with that of Evans (1938) and Edwards (1941) except as regards *Culex fatigans* Wied. where the synonym *C. quinquefasciatus* Say has been used.

Anopheles (Anopheles) coustani var. *ziemanni* Grünberg.

Larvae were collected from shaded yam irrigation ditches in clear water. This does not quite agree with records from Southern Nigeria where the larvae are reported to be restricted to shallow grassy pools or ponds exposed to the sun (Barber and Olinger, 1931). Observations at Dakar showed this species to prefer shaded areas for breeding in conformity with the habits of most species of the subgenus *Anopheles*.

Adult females were extremely rarely encountered in native dwellings even when they were breeding nearby. Less than a half dozen adults were taken in grass huts during a season of collecting. This confirms observations in Kenya where the variety was rarely found in human habitations and was shown to be zoophilic (Symes, 1932). On the other hand it is interesting to note that the type form has been found in Mauritius at all hours of the day or night in human dwellings (MacGregor, 1924, cited by Evans, 1938).

Anopheles (Myzomyia) funestus Giles.

Larvae were taken in locations which varied from quite shady to exposed areas. Types of breeding places included the edges of swamps, small clear ponds, drainage ditches, irrigation ditches, native wells, temporary rain pools, and the shaded grassy edges of a lake shore. This anopheline seemed about as adaptable to a variety of breeding sites as did *A.*

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gambiae and in this respect conditions at Dakar emphasize the principle that generalizations as to the more restricted breeding habits of *funestus* must be viewed with caution (Evans, 1938). In many instances both *funestus* and *gambiae* were found breeding in association.

Adults were collected mainly in native dwellings throughout the year and there were usually more *funestus* than *gambiae* in the huts in total numbers. This species, together with *gambiae,* was one of the most domestic and androphilus mosquitoes encountered. In this connection it is interesting that most adults were consistently taken in grass huts and very few in native houses constructed of wood. This is pertinent to the observation that although it has been recorded as sometimes numerous in European homes in Nigeria, *funestus* is usually much more abundant in native dwellings (Evans, 1938). The darker and more ill-ventilated huts seemed most favored. Certain huts which were used exclusively for cooking purposes and thus were usually filled with smoke, also seemed to attract *funestus* females. It is fairly obvious that the microclimate of the grass hut is its favored haunt at Dakar.

Anopheles (Myzomyia) gambiae Giles.

Larvae were found in a variety of locations including small pools, drainage ditches, irrigation ditches, the edges of small streams, edges of swamps, temporary rain pools and puddles, stream overflows, sand pools and pits of clear water, shallow wells ranging from several inches to one or two feet deep, and wells of at least five or more feet in depth. These breeding places were nearly always exposed to direct sunlight or at least partially exposed. However, in some cases, such as the deep wells, there was considerable shade. An interesting breeding place was a small pond about ten inches deep filled with turbid and malodorous water of high organic content and covered with an abundant growth of blue-green algae. The *gambiae* larvae were found during March and April in clear open spaces in breaks of the algal mat. *Culex thalassius* larvae were also breeding in this location and as the culicine population increased the anophelines decreased so that no *gambiae* larvae were in evidence two months later. Whether this was due to competition for food, changes in temperature, increase in the algal mat, or other factors was not determined. Changes in organic content may have been the critical factor since it has been shown that raising the organic content of water by the addition of elephant grass has the effect of replacing anopheline fauna with culicines (Hopkins, 1933, cited by Evans, 1938).

Adult females of this species were taken almost exclusively in native homes. As already stated, *gambiae* ranks with *funestus* as regards domesticity and its preference for human blood. The typical native hut, in which these anophelines were taken, is made of a grass roof and walls, the roof being a pyramid set upon a rectangle or square. The huts varied from about 400 to 1,400 square feet in surface area. The floors were usually sandy, sometimes being covered with a grass mat. Several people commonly lived in a hut which was regularly filled with the smoke of cooking.

Both *A. gambiae* and *A. funestus* were observed to rest at about bed level, where the beds were standard height, and the population thinned out toward the floor. Where the beds were very low, females were found resting near the floor and generally under the bed. Where the ceilings were comparatively low, large numbers of adults were found at the junction of the roof and wall and on cobwebs in corners. Adult females invariably sought places sheltered from the light. Favorite resting places were the folds of native clothing and rags hanging on the walls, tin cans, boxes, and other types of containers with dark interiors. If one disturbed these objects a cloud of anophelines usually came flying out. These observations are similar to those made in Uganda on the habits of *gambiae* in dwellings (Gibbins, 1933).

In cases where natives had placed mosquito nets over their beds most of the *gambiae* and *funestus* in that hut were found resting under them. This was made possible by the prevalent habit of keeping one side of the net folded back during the daytime. It was not determined whether the people made efforts to drive the anophelines from under the nets upon retiring at night. The high incidence of malaria would seem to suggest a negative answer.

Although both species were, generally speaking, negatively phototropic, it should be noted that they were occasionally taken while resting in bright places near holes in the grass wall of the hut with a strong wind blowing directly upon them.

Anopheles (Myzomyia) pharoensis Theobold.

Larvae were taken from a small slow stream and a pool formed by a stream. Immature stages were not taken in most of the places observed where adults were occasionally collected.

Adult females were taken in native grass huts and during the period July to December a total of twenty-one were collected. This scarcity of adults in human dwellings seems to confirm observations made at Uganda (Gibbins, 1933). On the other hand, *pharoensis* has been observed to enter houses in large numbers in Egypt and in that region is considered to be a domestic species. Since larvae were seldom collected in or about most of the native villages at Dakar it is possible that the paucity of this species in our collections from human dwellings may have been due to the fact that the villages examined were distant from its breeding grounds (Gibbins, 1933) or that it was to be found outside of the huts because of a predilection for animal blood (Symes, 1932). Some of the native huts in certain villages usually yielded one or more adults quite regularly. This led to the speculation, although it was never proved, that the *pharoensis* adults were emerging out of native wells in these areas. The only other alternative was that the adults were flying in from considerable distances, but the freshness of the specimens made such an assumption doubtful.

Ficalbia (Mimomyia) splendens Theobald.

The only record is of two adult specimens taken in sweepings from heavy grass surrounding a small pond in open country.

Taeniorhynchus (Coquillettidia) metallicus Theobald.

Immature stages were not collected. A total of four adults were taken between May and June. Two specimens were collected while resting on the top side of mango leaves and the other two were taken in native grass huts.

Taeniorhynchus (Mansonioides) africanus Theobald.

Larval stages were not collected. About forty-nine adults were taken between May and June in native dwellings. Of the specimens taken, many were collected under mosquito nets where they were resting along with large numbers of *Anopheles gambiae* and *A. funestus.*

Taeniorhynchus (Mansonioides) uniformis Theobald.

Twenty adults were taken in native grass huts, but this species was not as abundant in human dwellings as *T. africanus.* As in the latter case, many of the adult females were found resting under bed nets in association with the malaria-carrying anophelines. Larvae were not collected.

Aëdes (Mucidus) scatophagoides Theobald.

Adults were never taken in native dwellings. Of the two specimens collected in August, during the rainy season, both were collected as larvae. One larva was taken from a rain puddle, in turbid water, exposed to sunlight, no vegetation, and filled with tadpoles, minute crustacea, and other aquatic insect larvae. The second specimen was taken from a grassy pool with about two inches of turbid rain-water and exposed to the sun.

Aëdes (Stegomyia) aegypti Linnaeus.

Larvae were mainly collected from small holes in the trunks of baobab trees. In all cases the water was very clear, about one to three inches deep, and mature larvae were observed in these tree-holes four days after a rainfall. In one instance larvae were taken from a metal barrel exposed to the sun and containing turbid water about six inches deep.

It is interesting that during a year of collecting in native huts of the villages around Dakar no adult specimens of this important species were taken. At the same time there was abundant evidence of its breeding in proximity to these villages during the rainy season. The reasons for this are not clear, although the statement has been made that *aegypti* shows a supposed preference for feeding on Europeans in Africa (Edwards, 1941). Since this species is considered to be highly domestic throughout the Ethiopian region it should also be noted that in Mombasa, British East Africa, *aegypti* was collected by two of the authors several hundred feet from their tent in a shaded grove. It apparently never made an attempt to enter the tents even during the night. Edwards (1941) cites evidence presented by Hopkins that *aegypti,* in Kampala, occurs in European homes and not in native huts.

Aëdes (Stegomyia) metallicus Edwards.

Considerable numbers of larvae were taken in association with *aegypti* larvae in baobab tree-holes. For the most part these tree-holes contained clear rainwater. In one instance larvae were collected from tree-holes filled with turbid water of high organic content. As in the case of the yellow fever mosquito, no adults were collected in native dwellings.

Aëdes (Aëdimorphus) punctothoracis Theobald.

Larvae were found in small muddy pools surrounded by grass in the shade of palm and mango trees. Adults were taken in sweepings of the surrounding grass in these shaded groves. Adults were never collected in native huts.

Aëdes (Aëdimorphus) irritans Theobald.

The greatest numbers of immature stages were taken from crab holes in clay soil and in brackish pools. Larvae were also collected in native concrete wells in clear drinking water, about ten feet deep, exposed to the sun and devoid of vegetation. Only two adults were taken in native dwellings throughout the season. A considerable number of adults were collected during the daytime as they rested inside crab holes.

Aëdes (Aëdimorphus) ochraceus Theobald.

Large numbers of larvae were taken during the rainy season in temporary pools containing turbid water and exposed to the sun. Adults were never collected in native huts.

Culex (Lutzia) tigripes Grandpré and Charmoy.

Throughout most of the season larvae were taken in irrigation ditches between hills of yams near a native village. The water contained much algal material and was exposed to the sun. *Anopheles gambiae* larvae were also breeding in this location and it is possible that *tigripes* may have been feeding on this anopheline since its breeding places "seem to be limited more by the presence or absence of other larvae on which to prey than by any other factor" (Hopkins, 1936).

During the rainy season larvae were collected in small temporary pools, two or three inches in depth, with grass around the edges and clear water. On one occasion larvae were taken from a small circular pool in a grassy field, the pool being about eight feet in diameter and filled with cat-tails. The water was turbid, high in organic content and quite malodorous. Larvae were also collected in native concrete wells and in sandy water holes in association with anophelines.

The single adult specimen collected was in sweepings from grass located in a shaded grove of palm and mango trees near muddy pools.

Culex (Culiciomyia) nebulosus Theobald.

Quite a number of larvae were taken during the rainy period from baobab tree-holes in clear water. These were in association with *Aëdes aegypti* and *A. metallicus*. Adults were noted near tree-holes resting on branches, but they were never taken in native huts.

Culex (Culex) bitaeniorhynchus Giles.

Larvae were collected in stagnant water in a swamp filled with profuse growth and abundant filamentous green algae, small crustacea such as *Cyclops* sp. and exposed to the sun. Larvae were also taken in irrigation ditches containing profuse algal growth and directly exposed to the sun. Adults were never seen in native huts.

Culex (Culex) thalassius Theobald.

Although larvae of this species were taken in diverse locations, most of the material was collected in small ponds about ten inches deep and containing turbid malodorous water. These ponds were exposed to sunlight, grass was quite heavy about the fringes and the water level fluctuated slightly from month to month. There was an abundant growth of blue-green algae and the larvae seemed to gather at breaks in the algal mat. Small crustaceans, syrphil fly larvae and desmids were characteristically in evidence and it has already been mentioned above that larvae of *Anopheles gambiae* were found in this locality during the spring months when the *thalassius* larvae were not yet numerous.

Other breeding sites included temporary rain pools, brackish pools, edges of swamps, and small pools from a stream overflow. In most cases observed the larvae were exposed to the sun and the water was fairly warm. This was especially true of the pools of foul-smelling water noted above. The adaptability of the larvae at Dakar confirms earlier observations on this species elsewhere (Ingram and Macfie, 1917).

Adults were collected in moderate numbers, mainly during May and June, from native grass huts. During the period in which adults were collected in native dwellings they were among the most numerous of the culicines taken in this location.

Culex (Culex) tritaeniorhynchus Giles.

Immature stages of this coastal species were not collected. One adult female specimen was taken in a native hut and several adults were taken in sweepings from shaded grass near a stagnant pool in a wooded region.

Culex (Culex) duttoni Theobald.

Although this is considered to be one of the most common species of *Culex* in tropical Africa, very few specimens were collected at Dakar. Larvae were taken in an irrigation ditch in clear water and exposed to the sun; and they were also collected from a shallow sandy water hole, exposed to the sun, with slightly turbid water. *Anopheles gambiae* larvae were in association. Three adult specimens were taken from native huts during the year.

Culex (Culex) quinquefasciatus Say.

This was the most domestic species of culicine collected and it was found breeding mainly in the proximity of native villages in a variety of places. Types of breeding locations included the following: polluted drainage water in a drainage pit covered with a concrete slab; baobab tree-holes associated with *Aëdes* larvae; in a concrete tank exposed to sunlight with water covered by algae; in metal and wooden barrels containing turbid water; in native wells containing clear drinking water; in temporary rainpools, in puddles, holes, and pits either shaded or exposed to the sun.

Adults were collected throughout the year in native grass huts. Females were in the habit of resting under bed nets and in dark corners and containers along with the two anophelines of importance.

Culex (Culex) antennatus Becker.

Larvae were taken in the following locations: stagnant swamp water covered with algae; irrigation ditches between yam

hills in clear water with some algae; small temporary rain pools in clear water; native concrete wells about ten feet deep with clear water; small pools in grassy fields containing turbid foul-smelling water; sandy holes with clear water and exposed to the sun; and in a wooden tank containing clear water. Observations at Dakar are not fully in accord with the statement that larvae of this species usually occur in stagnant water (Hopkins, 1936). Adults were not collected in native dwellings.

Culex (Culex) decens Theobald.

The only record of larval collection we have is from a native well in clear water exposed to the sun. Adults were collected in very meager numbers from native grass huts during the spring months.

Culex (Culex) invidiosus Theobald.

One larval collection was made during August in a small grassy pool with turbid water of high organic content and exposed to the sun. Adults were not encountered in native homes.

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NEWS AND NOTES

PAN AMERICAN CONFERENCE ON MALARIA. Mr. Harry H. Stage, Division of Insects Affecting Man and Animals, Bureau of Entomology and Plant Quarantine, attended the Third Pan American Conference on Malaria, held in Maracay, Venezuela, January 5 to 11, 1947, and the Twelfth Pan American Sanitary Conference held in Caracas, Venezuela, January 12 to 24.

Delegates, members, and other invited guests attending the Malaria Conference included:

Dr. G. Robert Coatney, Section Malaria Drug Testing, National Institute of Health, Bethesda, Maryland.

Dr. Carlos Alberto, Alvarado, Division de Paludismo, Tucuman, Argentina.

Dr. A. L. Ayroza Galvao, Facultade de Medicina, da Universidade de Sao Paulo, Sao Paulo, Brasil.

Dr. Arnoldo Gabaldon, Division de Malariologia, Maracay, Venezuela.

Dr. Hernando Rey, Departmento de Malariologia Ministerio de Trabajo, Higiene y Prevision Social, Bogotá, Columbia.

Dr. Juan A. Montalvan, Institute Nacional de Higiene, Direccion General de Sanidad, Guayaquil, Ecuador.

Dr. Victor Arnoldo Sutter, Calle Cuscatlan 52, San Salvador, El Salvador.

Dr. Henry P. Carr, The Rockefeller Foundation, Apartado 195, Ciudad Trujillo, Republica Dominicana.

Dr. Rolla B. Hill, The Rockefeller Foundation, Apartado 2508, Bogotá, Colombia.

Dr. Estus H. Magoon, The Rockefeller Foundation, Apartado Postal 1710, Habana, Cuba.

Dr. John Maier, The Rockefeller Foundation, Division de Malariologia, Maracay, Venezuela.

Dr. Paul F. Russell, The Rockefeller Foundation, Division de Malariologia, Maracay, Venezuela.

Dr. Louis Vargas, Instituto de Salubridad y Enfermedades Tropicales, Mexico, D. F., Mexico.

Dr. Arturo Luis Berti, Division de Malariologia, Maracay, Venezuela.

Dr. Pablo Cova Garcia, Division de Malariologia, Lima, Peru.

Mr. E. D. Hopkins, Senior Sanitary Engineer, Oficina Sanitoria Panamericana, Lima, Peru.

Dr. Salvador Jose Carillo, Jefe, Servicio de Proyectos, Seccion de Ingenieria Antimalarica, Division de Malariologia, Maracay, Venezuela.

Dr. J. Romeo De Leon, Director General de Sanida, Guatemala, Guatemala.

Dr. Antonio Gomez Marcano, Encargado, Seccion de Actividades Medicas, Division de Malariologia, Maracay, Venezuela.

Dr. Gerardo Gonzalez, Jefe, Serncio de Fomento Antimalarica, Seccion de Ingenieria, Division de Malariologia, Maracay, Venezuela.

Ing. Manuel Lacayo, Oficina Interamericana de Salud Publica, Caracas, Venezuela.

Dr. Mario Montesinos, Jefe, Laboratorio de Materiales, Seccion de Ingenieria, Division de Malariologia, Maracay, Venezuela.

Colonel E. W. Steel, Asesor, Instituto Nacional de Obras Sanitarios, Caracas, Venezuela.

The meetings of the Pan American Conference on Malaria were held in the School of Malariology in Maracay, which is under the direction of Dr. Arnoldo Gabaldon. The agenda of the Commission included problems of organization, taxonomy of the malaria vectors, chemotherapy of the disease, engineering, insecticides, and dissemination of information on all subjects related to malaria. Dr. Arnoldo Gabaldon presided over the Conference.

Mr. Stage presented a paper "New Methods and Recently Developed Insecticides and Appliances for Controlling Mosquitoes" which will be published in Spanish in "Tijeretazos sobre Malaria," a periodical sponsored by the Division de Malariologia, Ministerio de Sanidad y, Asistencia Social, Maracay, Venezuela.

Venezuela is carrying on a very effective malaria control program, spending approximately two and a half million dollars annually, of which approximately one million is for DDT alone. There are 2,000 stations located in 1,000 villages of the country for the free distribution of atabrine. By this method, approximately 800,000 treatments are dispensed annually. Field trials of three new antimalarials developed as a result of the war effort were inaugurated over a year ago in the State of Trujillo. The trials on chloroquine will be continued through at least another season. Malaria control has apparently reached a world-wide peak in Venezuela. Indeed, the program is so well organized and so efficiently conducted that Dr. Paul F. Russell of the International Health Division, Rockefeller Foundation, has found it necessary to leave Venezuela for more fertile malaria fields in which to conduct his research on this disease. Dr. John Maier of the same organization is staying on for the present cooperating on research projects with the school of malariology especially on the relative effectiveness of several DDT formulations when applied to a wide variety of materials such as thatch, adobe, painted and unpainted surfaces, and others.

At the Twelfth Pan American Sanitary Conference held at Caracas, Venezuela, from January 12 to January 24, 1947, Dr. Fred L. Soper of the Rockefeller Foundation was elected director of the Pan American Sanitary Bureau, succeeding Dr. Hugh S. Cumming, Surgeon General, United States Public Health Service, retired, who was elected Director Emeritus.

The United States delegation to the Twelfth Pan American Conference included:

Chairman—Dr. Thomas H. Parran, Surgeon General, U. S. Public Health Service.

Delegates—Mr. John C. Dreier, Division Special Inter-American Affairs, Department of State; Dr. Richard J. Plunkett, Director, Division of Health and Sanitation, Institute of Inter-American Affairs; Mr. William Sanders, Division International Organization Affairs, Department of State; Dr. Fred L. Soper, International Health Division, Rockefeller Foundation; Dr. L. L. Williams, Jr., Division International Labor, Social and Health Affairs, Department of State.

Advisors—Mr. Ward P. Allen, Division International Organization Affairs, Department of State; Dr. Robert H. Coatney, National Institute of Health, U. S. Public Health Service; Colonel Wesley C. Cox, M.C., Chief, Army Industrial Hygiene Laboratory; Dr. James A. Doull, Chief, Office of International Health Relations, U. S. Public Health Service; Dr. Juan R. Pons, Health Commissioner, Puerto Rico; Mr. Harry H. Stage, Assistant Chief, Division of Insects Affecting Man and Animals, U. S. Department of Agriculture; Capt. Van Collier Tipton, M.C., U. S. Navy.

Members and visitors, Third Pan American Conference on Malaria, Maracay, Venezuela.

Committee on Taxonomy, Third Pan American Conference on Malaria, Maracay, Venezuela. Reading from left to right: Dr. Luis Vargas, Dr. Pablo Cova Garcia, Dr. A. L. Ayroza Galvao, and Dr. Arnoldo Gabaldon.

Division de Malariologia, Ministerio de Sanidad y Absistencia Social, Estados Unidos de Venezuela, Maracay, Venezuela.

"JERSEY MOSQUITO GOES TO EUROPE." "Jersey 'skeeters' which play the leading roles in an educational motion picture entited 'The Life Cycle of the Mosquito' will be viewed by an international audience at Brussels, Belgium, in June.

"The mosquito film has been selected as one of ten educational films produced in the United States during 1946 to be entered in the World Film Festival at Brussels where it will compete with films from other nations for important awards.

"Produced by Emerson Yorke Studios of New York in cooperation with the Entomology Department of Rutgers University, the U. S. Public Health Service and the Rockefeller Foundation, the film shows how mosquitoes breed and live." State News Service, Extension Service, N. J. Coll. of Agr., Rutgers Univ.

HOWARD-KRAUSS SOCIETY. Letter to the Secretary.

Mr. Thomas D. Mulhern
Secretary-Treasurer
American Mosquito Control Assn.
New Brunswick, New Jersey

Dear Mr. Mulhern:

The Howard-Krauss Society of South Side High School wishes to thank you for circular # 502, "Story of the Mosquito," which, like everything else the New Jersey Mosquito Extermination Association has sent us, is invaluable. This will be used on the April 30th program, at which meeting we are also using selections from "Proceedings of the Thirty-third Annual Meeting of the New Jersey Mosquito Extermination Association." Both brochures are important additions to our pamphlet library.

"Life-Cycle of the Mosquito" was shown to the entire student body, April 22, in the school auditorium. We, who have studied mosquito control, realize that this film is an unusual photographic and scientific achievement. All the students seemed to enjoy the film.

This year we did not get out a Mosquito edition of our school paper, although we hope to publish one in the future. We did have several articles about our society's work in various issues of "The Triple S."

Our 1946–47 project was directed toward a Pan-American health program which we presented to the student body in our school auditorium. Part of this program was carried to several other schools.

We are glad to hear that our summary of the play, "Quarreling With the Quad," will be published in the September issue of MOSQUITO NEWS.

Thank you for your help and your interest in our society. Such interest as yours is an inspiration to all our members.

Very truly yours,

Annetta McMorries
Recording Secretary
Junior Howard-Krauss Society

R. H. NELSON is in charge of the insecticide testing, Division of Control Investigations, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. Mr. Nelson, a graduate of the University of Nebraska in 1930, has been with the Bureau since 1931, but only recently undertook work with mosquitoes.

Nathan Stahler, who is at present working with the Naval Medical Research Institute at Bethesda, Md., in the department of Malariology, graduated in Entomology from the University of California in 1939. He joined the staff of the Bureau of Entomology and Plant Quarantine, but, like Mr. Nelson, began to work with mosquitoes only recently in his present capacity.

Donald Snow of the Pan American Bureau is temporary general secretary of the Inter-American Association of Sanitary Engineering, organized only last year in South America.

H. L. T.

DR. PAUL RUSSELL, one of our older and better known members, has returned to this country from Geneva, Switzerland, where, as a member of the Expert Committee on Malaria, he attended the World Health Organization Interim Commission's meetings. Dr. Russell is at present located in the Laboratories of the International Health Division, Rockefeller Institute, York Avenue and 66th Street, New York City. In addition to his other duties, he is Chairman of the Malaria Study Section of the Research Grants Division of the U. S. Public Health Service.

H. L. T.

F. C. BRETHOUR of Washington, D. C., one of our newer and jovial members, who with his attractive wife attended the meetings at Atlantic City, has been much interested in killing mosquitoes via the machines he represents, Buffalo Turbines. He was very much occupied with his custom spray contracts for insect control in nearby Virginia communities this summer.

H. L. T.

Editor's Note: The following items were copied from *Mosquito Buzz* of August 15, 1947, as individually indicated. *Mosquito Buzz* is "Published monthly as a joint news-sheet of the California Mosquito Control Association and the mosquito control section of the California State Department of Public Health." (MAD is a contraction of "Mosquito Abatement District.")

SEVENTEEN MOSQUITO CONTROL AGENCIES APPLY FOR SUBVENTION. Thus far, seventeen agencies engaged in mosquito control, have made written application to the (California) State Department of Public Health for subvention assistance in the control of mosquito vectors of malaria and encephalitis.

Applications have been carefully analyzed and negotiations between the Bureau of Vector Control and each applicant are in progress to assure complete understanding before contracts are let.

On the basis of approved applications, contracts are being prepared and they will be distributed to the individual agency in the near future.

It is expected that the total number of applicants will reach twenty.

Contracts for this year are designed to assure uniform spending of money in keeping with the need, and likewise to ascertain that the full amount of vector control is obtained from each dollar spent.

Mosquito Buzz

H. Gray Achieves Distinction. Name Appears in Who's Who. In the current edition of *Who's Who* is to be found the name of a prominent California mosquito control worker—Harold F. Gray. His name has landed in this lofty annal as a result of outstanding accomplishments in the fields of engineering, education, mosquito control and public service.

Mosquito Buzz

Dr. Morris MAD Experiments Evaluate DDD as a Larvicide. Claims concerning the effectiveness of the chlorinated hydrocarbon DDD as a mosquito larvicide, plus the statement that this material is less toxic than DDT to warm blooded animals, lured the Dr. Morris MAD into making field tests in order to determine its efficiency in the Bakersfield area. Tests were conducted by S. Ochoa, A. F. Geib and G. F. Smith.

Using a cylindrical type sprayer, alternating mist and fan spray nozzles, a total of six tests were run with rates of application varying between .24 lb. per acre and .82 lb. per acre. The sources treated, all containing *Aedes* larvae, and one containing *Culex* as well, included: a recently cut alfalfa field, a permanent pasture, alfalfa field, alfalfa field with some grass, tule growth with light floatage, and an alfalfa field with heavy Bermuda grass and some Johnson grass.

Observations of the kill accomplished in these tests, led to the conclusion that the material used readily kills first, second and third instar larvae, but is not effective on fourth instars. The DDD material used was from a 5 gallon sample of commercial run Rothane D-3.

Mosquito Buzz

Eastside MAD Uses DDD by Air. Accomplishes Near Total Kill. Chet Robinson reports a trial use of DDD for the control of *A. freeborni* and *C. tarsalis* larvae in a densely overgrown rice field with nearly complete kill.

On another airplane application, DDT was used to spray a peach orchard owned by Roy Holmes, Trustee of the district. The spraying was o.k.'d by the cannery and the California Cling Peach Association.

Mosquito Buzz

Alameda County MAD Deals Out Death to Cemetery Skeeters. In Alameda County there are strong indications that mosquitoes no longer will be able to rest peacefully in the local cemeteries. Aerosol test experiments have thus far been partially successful.

Harold Gray reports that aerosol application is a considerable time saver in contrast to the practice of controlling the water-filled containers individually; especially when one cemetery has over 27,000 of them. The work thus far has been more effective on adult mosquitoes than on the larvae.

District Entomologist, Ted Aarons, states that *Culex pipiens* is the most common mosquito collected, with *Culiseta incidens* second in dominance. *Culex tarsalis* and *stigmatosoma* have also been taken from the flower containers.

Residents surrounding the cemeteries are very much behind the district in its objective of controlling the estimated 25,000 mosquito per week output.

Mosquito Buzz

Paint Thinner for Cleaning Equipment. Bill Guerry, Division Foreman, is a bearcat for keeping his division's equipment clean. To clean the oily dirt and DDT off the trucks, he has the men use a rag soaked in paint thinner. If the DDT won't loosen easily, a little solvent is used. Bill advises against using a steam cleaner on the working parts of a vehicle, since he says this drives the grit and dirt into the springs and fittings.

Mosquito Buzz

Saves Hand Pumping. Bill Wininger, tired of pumping the hand sprayer by hand, decided to abandon the practice. He has tapped a tire tube valve in the orifice of his Kero-O-Kil sprayer where a pressure gauge might be located and from now on he'll get his "charge" from a gas station compressor or his Essick power sprayer. One charge will last for a filling of larvicide.

Mosquito Buzz

Encephalitis Virus Recovery from *Culex tarsalis* Pools. By the end of July, over 900 pools of mosquitoes had been submitted to the State Virus Laboratory by the personnel engaged in this function throughout the Central Valley. Of these, 63 pools of *Culex tarsalis* had been injected into mice, resulting in approximately one-third positive for virus, with several proven to be the western equine strain. Mosquitoes are frozen and in this condition the virus is preserved so that laboratory injections of the mosquitoes may be made at some future time.

Thus far the positive findings are not restricted to any particular part of the Central Valley, but are from random collections of mosquitoes sent in from each collector's zone.

Mosquito Buzz

Editor's Note: From the Virginia "Skeeter," Official Organ of the Virginia Mosquito Control Association.

"Common Glory" a Success So Far as Mosquitoes Are Concerned. The Richmond *Times*

Dispatch, Sunday, July 20, 1947, in reviewing the symphonic drama, "Common Glory," which opened on July 17th, at Williamsburg, had the following to say, "Best of all, the entire area had been sprayed with DDT solution and, though the frogs croak in the nearby waters and the night birds twitter until the lights go up, there's not a fly, gnat, or mosquito within a mile of the stage."

This situation is not an act of God but is the result of a good work done by the Williamsburg Mosquito Control Commission.

Skeeter.

THE VIRGINIA ASSOCIATION now numbers one hundred and twenty-one (121) members.

Skeeter.

CHANGE IN DATE OF INTER-AMERICAN SANITARY ENGINEERING CONFERENCE, SANTIAGO, CHILE. Word has been received by Donald E. Snow, Acting Secretary, from the Chilean Section of the Inter-American Association of Sanitary Engineering that the Third Inter-American Sanitary Engineering Conference must be postponed until April, 1948. Definite information on the new conference dates will be published when available.

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EDITORIAL SECTION

THE A.M.C.A. GOOD NEIGHBOR CLUB

Won't You Share This Contribution to the Good Neighbor Policy?

Several members of the American Mosquito Control Association have already signed up to form an A.M.C.A. "Good Neighbor Club." Every member of the Association is invited to join.

The condition of membership in this A.M.C.A. Good Neighbor Club, is that each member of the Club shall, in addition to his own membership in the Association, buy one or more extra subscriptions to Mosquito News to be sent to key libraries in Europe and elsewhere. Libraries partially or entirely destroyed by war would be given particular consideration.

The project promises several satisfying returns:

1. Such a contribution could only be construed as a part of our National "Good Neighbor" policy.
2. It would be a contribution toward building up worthy scientific libraries in needy countries.
3. Our Association would benefit through this wider circulation of Mosquito News, and from its stimulating effect on the sale of advertising space.

Dr. George E. Strode, Director of the Rockefeller Foundation, has agreed to provide a list of key institutions to which our "Good Neighbor" subscriptions might be sent. Any member of the "AMCA Good Neighbor Club," however, may specify the particular institution to which he would like his subscription sent, if he should care to do so.

Let's get at least 100 "Good Neighbor" subscriptions to Mosquito News. Send your three dollars to H. H. Stage, Chairman, A.M.C.A. Good Neighbor Club, U. S. Bureau of Entomology and Plant Quarantine, Washington, D. C. He will arrange to have the Secretary of the Association enter the name of a worthy institution (the institution you may specify if you wish) on the Mosquito News mailing list.

With the initial number of Mosquito News, an appropriate statement will be forwarded to the library or other institution selected.

REVIEWS AND ABSTRACTS

DDT AND ITS APPLICATION IN VETERINARY MEDICINE. By C. R. Twinn. Can. J. Comp. Med. Nov. 1946: 301–314.

A discussion is given on the composition of DDT, its properties, mode of action and toxicity to insects and higher animals. Methods of using DDT to control insects affecting domestic animals are described for each of the insect species of importance to veterinarians in Canada. The report is based on a bibliography of 35 titles and on unpublished reports.

For fly control 1, 3, 4, and 5 per cent DDT-oil solutions and emulsions were used successfully as residual treatment in buildings applied at the rate of one imperial gallon to 1600 sq. ft. of surface. Manure pits were sprayed with 1 per cent solutions. The recommendations for mosquito control were to: (1) spray vegetation sheltering adults with 1 per cent DDT suspensions or aqueous emulsions at the rate of 4 to 5 gallons per acre; (2) for larval control apply 1 to 2 quarts of 5 per cent DDT-oil solution per acre with atomizing spray equipment or airplanes; (3) with ordinary hand equipment apply 2 to 3 gallons of a 1 per cent solution. Blackflies may be controlled by adding DDT either as a suspension or emulsion to the streams to give 1 part of DDT to 10 million parts of water at the point of application. It is suggested that this use of DDT needs further investigation to determine how the treatment affects other forms of aquatic life. Area spraying by air, aerosols or fogging with smoke generators have given appreciable reduction of blackflies. The horn fly was satisfactorily controlled in Ontario by spraying cattle with a 0.25 per cent water suspension. Results of other workers who successfully used 2½ to 1 per cent strengths as dips or sprays are also cited. The results of various workers summarized here indicate that DDT was not satisfactory for the control of bot and warble flies.

DDT applied to sheep as an emulsion in concentrations of 0.24 to 0.45 per cent still showed toxicity to sheep blowflies 5 weeks after application and was effective in preventing oviposition for about 6 weeks. The sheep ked was controlled by dipping or spraying sheep with 0.2 to 0.25 per cent DDT emulsions or suspensions. Fleas were controlled for 3 months on foxes with one application of a 10 per cent powder. The residual sprays applied in infested buildings provided satisfactory control as did applications of 8 oz. of 10 per cent powder per 1000 sq. ft. Either the residual sprays or dust applications will control bedbugs in chicken houses. Lice, both sucking and biting, on domestic animals, are controlled with DDT dust sprays or dips. The procedure to use for each type of animal is described. Various methods of using DDT for the control of ticks are described and mention is made of the relative ineffectiveness against mites.—B. V. TRAVIS, Bureau of Entomology and Plant Quarantine, U. S. Dept. Agric., Orlando, Fla.

EL DDT Y SU APPLICACIÓN A LA MEDICINA VETERINARIA. (DDT and Its Application to Veterinary Medicine.) Por C. R. Twinn, Can. J. Comp. Med. Nov. 1946: 301–314.

Se discute la composición del DDT, sus propiedades, modo de hacer sentir sus efectos y su toxicidad para insectos y animales de más alta categoría. Se hace una descripción de los métodos de usar el DDT en el control de los insectos que atacan a los animales domésticos, para cada una de las especies de insectos de importancia para los veterinarios del Canadá. El informe se basa en un bibliografía con 35 títulos y en informes inéditos.

Para el control de la mosca *(Diptera)* se emplearon con éxito soluciones y emulsiones al 1, 3, 4 y 5 por ciento de DDT en aceite para el tratamiento residual en edificios, applicados a razón de un galón imperial para cada 1600 pies cuadrados. Se rosiaron los estercoleros con soluciones al 1 por ciento. Las recomendaciones para el control de mosquitos fueron: (1) rociar la vegetación encubridora de adultos con emulsiones al 1 por ciento de DDT en suspenso o en agua a una razón de 4 a 5 galones por acre; (2) para el control larvario, aplicar 1 ó 2 cuartas de solución de DDT en aceite al 5 por ciento para cada acre, empleando aparatos de rociar vaporizado o aeroplanos; (3) con el equipo manual corriente, aplicar 2 a 3 galones de una solución al 1 por ciento. Se pueden controlas los simúlidos *(S. hirtipes)*, depositando DDT, sea en suspensión o en emulsión, en las corrientes para dejar 1 parte de DDT a las 10 milliones partes de agua en el punto de applicación. Se hace la superencia que éste uso del DDT recama más experimentación para averiguar cuales son los efectos de este tratamiento con relación a otras especies de la fauna aquática. Se ha hecho una diminución considerable en la población de simúlidos rociando desde el aire, con aerosoles o con neblinas producidas por generadores de humo. Se logró un control satisfactorio de la *Haematobia serrata* en Ontario con rociar el ganado con una suspención en agua al 0.25 por ciento. Se citan también los resultados obtenidos por otros investigadores que han empleado potencias de 2-½ ó 1 por ciento con imersiones o rociados. Los resultados obtenidos por varios investigadores aquí sintetizados indican que el DDT no es satisfactorio en el control del rezno *(Gastrophilus equi)* y el *Hypoderma bovis*.

El DDT aplicado al ganado ovino en emulsiones de concentraciones desde 0.24 hasta 0.45 por ciento aun demonstraban toxicidad contra la moscarda ovina *(Oestrus ovis)* hasta las 5

semanas después de aplicado y su eficacia en evitar la oviposición perduraba unas 6 semanas. Se controló el *Melophagus ovinus* por medio de imersiones de las ovejas o con rociarlas con emulsiones o suspensiones de DDT al 0.2 hasta 0.25 por ciento. Las pulgas en zorras se controlaron durante 3 meses con una sola aplicación de polvo al 10 por ciento. Las rociadas residuales aplicadas a edificios infestados dieron un control satisfactorio, como también aplicaciones de 8 onzas de polvo al 10 por ciento para cada 1000 pies cuadrados. Tanto los rociados residuales como las aplicaciones de polvo controlarán las chinches en los gallineros. Los piojos, tanto chupadores como mordedores, en animales domésticos, se controlan con pulverizaciones secas de DDT o por imersión. Se describe el procedimiento a usarse en cada tipo de animal y se hace referencia a la ineficacia relativa contra los ácaros.—Translation of a review in English by B. V. Travis.

Observations on the Night-Time Resting and Biting Habits of Anopheles Mosquitoes in DDT Treated and Untreated Buildings. Clarence M. Tarzwell and Frank W. Fisk. (U.S.P.H.S., Communicable Disease Center, Technical Development Division, Savannah, Ga.) Pub. Health Rep. 62(3):84–94. 2 fig. 1947. (Abstract.)

Studies of the night-time behavior and resting habits of anopheline mosquitoes were conducted in rooms to which wild mosquitoes had free access and the walls and ceilings of which were marked off into numbered squares to facilitate counting and recording. At regular intervals the positions of all mosquitoes were plotted on scale drawings of the walls and ceiling, the species, sex and resting time being shown for each mosquito. An analysis of the data showed that *Anopheles quadrimaculatus* which entered the building to feed on the bait animal rested on the walls and ceiling for considerable periods before as well as after feeding. The resting period of the females varied from a few minutes to over 11 hours and there was no significant difference between the means for unengorged and engorged mosquitoes, being 167±3 minutes for the former and 170±minutes for the latter. After treatment, their resting period varied from a few to 90 minutes averaging 40±3 minutes for the unengorged and 33±4 minutes for the engorged. After treatment, 31 per cent of the *A. quadrimaculatus* resting on the walls were engorged females whereas before treatment only 14 per cent were engorged females. It is probable many of the unengorged mosquitoes were irritated by the DDT and left before attempting to bite. Before treatment the number of *A. quadrimaculatus* females increased throughout the night, reaching a maximum about an hour before daylight while after treatment the largest number was present just after the influx at dusk and only a small number were present at any time during the remainder of the night.—C. M. Tarzwell.

Control of Anopheline Mosquito Larvae by Use of DDT-Oil Mists. Frederick F. Ferguson, Earl H. Arnold, and William M. Upholt. (Communicable Disease Center, Technical Development Division, U.S.P.H.S.) Public Health Reports, Vol. 62(9):296–302. 1947. (Abstract.)

Initial tests with DDT as a larvicide were with aqueous emulsions at total rates similar to those used for oil sprays. It was soon found, however, that when uniformly distributed, a gallon per acre of a No. 2 fuel-oil-DDT solution containing 0.5 per cent of a good spreader gave adequate control. This larvicidal material may be prepared by adding 2½ pounds of DDT and 1 quart of spreader to a 50 gallon drum of No. 2 fuel oil. For the application of this solution at 1 gallon per acre, small air-pressure hand sprayers fitted with mist or atomizing nozzles [Spraying Systems Co., 1/4LN 2.55; Marley Co., Inc., 1H41; Monarch Mfg. Co., No. 5, or equal] were satisfactory. When operated at pressures between 50 and 30 psi, these nozzles gave a discharge of 3 gph and droplet sizes of 70 to 220 microns. In operation, the sprayer was charged with 1 gallon of solution; and the vaporous oil mist was drifted with the wind, an effective swath width of 30 feet being obtained under normal conditions. Comparative field tests at equal dosages of DDT per acre indicated that oil mists at a gallon per acre were about as effective for mosquito control as emulsions applied at rates of 15 gallons per acre. Further, due to great reductions in material used and labor required, oil-mist larvicides are much cheaper than oil sprays and significantly less costly than DDT or paris-green dusts. All larval instars were susceptible to the mist spray.—C. M. Tarzwell.

Comparative Studies of DDT Dusts, DDT-Oil Sprays and Paris-Green Dusts Used Routinely in Anopheline Larva Control. Willis V. Mathis, Frederick F. Ferguson, and S. W. Simmons. (U.S.P.H.S., Communicable Disease Center, Technical Development Division, Savannah, Ga.) Pub. Health Rep. 62(3):95–102. 1947. (Abstract.)

Evaluations have been made of anopheline larvicides when used in a general malaria-control program. DDT was used in fuel oil emulsion, in undiluted fuel oil and in dusts at the rate of approximately 0.1 pound per acre. Paris green was used in a dust at the rate of approximately 1 pound per acre. Comparative cost of the different materials and man-hours required to apply each to a given area was determined. DDT-fuel oil used as an emulsion or undiluted spray (1 gallon of solution per acre) gave a higher degree of control than did paris-green or DDT dusts. Data from the control-operations records showed that the undiluted DDT-fuel oil

spray is more economical than other larvicides used, both as to the material cost and man-hours required to treat a given area.—W. V. MATHIS.

THE CONTROL OF RAT ECTOPARASITES WITH DDT. Russell G. Ludwig and H. Page Nicholson. (U.S.P.H.S., Communicable Disease Center, Technical Development Division, Savannah, Ga.) Pub. Health Rep. 62(3):77–84. 8 fig. 1947. (Abstract.)

Field studies to determine the effectiveness of a 10 per cent DDT, 90 per cent pyrophyllite dust mixture for rat ectoparasite control and to develop equipment and methods for its application were undertaken at Savannah, Georgia, in 1945. Extensive inspections were made and representative establishments having heavy infestations of rats and their ectoparasites were chosen for check and treatment, previous care being used to have similar types of buildings in each group. Live trapping was carried out in all buildings before treatment and at intervals after treatment to establish ectoparasite indices and the normal variation of ectoparasite populations so the results of treatment could be evaluated. Treatment was effected by blowing the 10 per cent DDT dust into burrows and enclosed harborages with a cyanogas foot pump duster, and by applying a layer of dust, with hand shaker dusters, along runways and around holes where it would be picked up by the rats and carried to nests and harborage areas. An average of 8 pounds of dust was used for each establishment. Of the 10 species of ectoparasites found on rats in Savannah, only *X. cheopis* was found in sufficient numbers and uniformity of distribution to permit an analysis of seasonal population variations. Consistent control of *X. cheopis* was obtained in all establishments with control percentages dropping off from an initial of 99.3 per cent by approximately 5 per cent per month for 4 months following treatment.—C. M. TARZWELL.

THE CONTROL OF HOUSE FLIES BY DDT SPRAYS. W. C. Baker, H. I. Scudder, and E. L. Guy. (U.S.P.H.S., Communicable Disease Center, Technical Development Division, Savannah, Ga.) Pub. Health Rep., Vol. 62(17):597–612. 1947. (Abstract.)

Effective control of *Musca domestica* for a period of 3 months was obtained in dairies by spraying both barns and outbuildings with a xylene-*Triton X–100* emulsion containing 2½ per cent DDT applied at the rate of 200 mg. DDT per square foot. A suspension of water-wettable DDT powder gave comparable results. Under poor sanitary conditions treatment of barn or outbuildings only was unsatisfactory. In restaurants effective control for 3 months or more was obtained by spraying ceilings and walls of dining room and kitchen with an emulsion containing 7½ per cent DDT and applied at the rate of 200 mg. DDT per square foot. In small food and ice-cream shops, 40–60 ft. of DDT-impregnated cord was hung as a replacement for electric light pull cords, along the chains of suspended display shelves, and from the kitchen ceiling at locations where the string would not interfere with the employees. Good control was obtained when the fly influx was not excessive. Emulsions containing ½ per cent DDT when applied at the rate of 300 and 200 mg. per square foot as a cover spray gave effective control for 3 weeks of adults emerging from grain wastes and from garbage washings in an alley. When nearby adult resting places were also treated, the control period was lengthened considerably.—W. C. BAKER.

EXTENDED LABORATORY INVESTIGATIONS OF THE TOXICITY OF DDT RESIDUES TO ADULTS OF *Anopheles quadrimaculatus*. R. W. Fay, S. W. Simmons, and J. M. Clapp. (U.S.P.H.S., Communicable Disease Center, Technical Development Division, Savannah, Ga.) Pub. Health Rep. 62(5):149–158. 1947. (Abstract.)

The residual toxicity of DDT to adult female *A. quadrimaculatus* mosquitoes is lost more rapidly at short exposure periods, i.e. 30 minutes, than at long exposure periods, i.e. 180 minutes. The loss of residual toxicity does not follow a single straight line relationship, but occurs more rapidly during the first 16 weeks and then shows little change for the next 6 months. Direct comparisons of mortalities show the 200 mg. DDT per sq. ft. deposits after 16 weeks to be about equal to the 100 mg. DDT per sq. ft. deposits after 12 weeks. The knock-down rate at the end of 60 min. exposures was a good indication of the 48 hr. mortality. There are indications that DDT in slow volatilizing solvents does not show as marked loss of residual in the first 12 weeks of aging as it does in fast volatilizing solvents. The male mosquitoes are more susceptible to DDT than the female adults.—R. W. FAY.

NOTES ON THE ANOPHELINES OF VENEZUELA AND THEIR IDENTIFICATION. By Pablo Cova Garcia. XII. Conferencia Sanitaria Panamericana, Cuadernos Amarillos No. 1. Publicacion de la Comision Organizadora. 208 pp., 52 unnumbered plates, 42 figs. Editorial Grafolit, Caracas, Venezuela. 1946.

Of the several regional treatments of the Anopheline mosquitoes that have appeared in the past few years, this is one of the best. It combines the best features of a taxonomic and faunistic treatise on the 30 species of Anophelini of Venezuela, with a well-conceived laboratory manual to train public health personnel and students of medical entomology in the identification and handling of these mosquitoes.

The book is very well organized. The eggs, larvae, pupae, adults, and male genitalia are each treated in separate sections, in this order. For the larvae and adults there is a discussion of the morphology and of the biology, followed by a laboratory guide to show students the essential characters necessary for the determina-

tion of each species in each of these stages. The morphology of the male genitalia and a similar laboratory guide is given for the males. The eggs and pupae are discussed more briefly with no laboratory guide. Excellent keys as well as a summary of characters in tabular form are given for the adults, the larvae, and the male genitalia. All of the stages are well-illustrated, and, while there is no key given for eggs, there are 11 plates showing the eggs of the known species and the variations within the species. The only stage not thoroughly covered is the pupal, and it is probable that too little is known about the specific characters in the species treated to permit complete descriptions and a key.

Following the first section, which permits the identification and assists the training for identification of the Anophelini of Venezuela in most of the stages, are 3 smaller sections. The first of these defines the tribes Megarhinini and Culicini and shows how they may be distinguished from the Anophelini. The second is a general discussion of the Anophelini including the history of the study of the tribe in Venezuela, distribution by state of the Venezuelan species, the position of the tribe in the animal kingdom, and of the Venezuelan species in the tribe, and a section on classification, nomenclature, and the preparation and use of keys. The last section deals with the internal anatomy and with the techniques of preparation, preservation, and the handling of living material in the laboratory.

Any person wishing to identify *Anopheles* from northern South America should find this book of immense value, and a student, knowing the Spanish language, wishing to train for laboratory work on these *Anopheles* can find here an invaluable study manual.—ALAN STONE, Bureau of Entomology and Plant Quarantine, U. S. Dept. of Agriculture, Washington, D. C.

NOTAS SOBRE LOS ANOFELINOS DE VENEZUELA Y SU IDENTIFICACION. Por Pablo Cova García. XII Conferencia Sanitaria Panamericana, Cuadernos Amarillos No. 1. Publicación de la Comisión Organizadora. 208 páginas, 52 láminas sin numerar, 42 figuras. Editorial Grafolit. Caracas, Venezuela. 1946.

De las varias consideraciones a base regional de los mosquitos anofelinos, que han visto la luz durante los últimos años, es ésta una de las mejores. Combina en sí los mejores factores de una tesis sobre la taxonomía y las características fáunicas de 30 especies de anofelinos en Venezuela, con un bien concebido manual de laboratorio para la formación de personal de salubridad pública y estudiantes de la entomoligía médica en la identificación y el manejo de estos mosquitos.

El libro está bien ordenado. Los huevos, las larvas, la ninfas, los adultos y las genitalias masculinas han sido consideradas en secciones por separado, en el orden dado a continuación. Respecto a las larvas y los adultos, hay una discusión de su morfología y biología, seguido de un guía de laboratorio para demonstrar a los estudiantes los caracteres essenciales que se requiéren en la determinación de cada especie en estas etapas. Se presenta la morfología de las genitalias masculinas y un guía de laboratorio parecido sobre los machos. Se discute más brevemente los huevos y las ninfas, sin guía de laboratorio. Hay excelentes claves, como también un resumen de caracteres en forma de tabla sobre los adultos, las larvas y las genitalias masculinas. Vienen bien ilustradas todas las etapas y, aun que non se presenta clave para los huevos, hay 11 láminas dando a conocer los huevos de las especies conocidas, con sus variaciones dentro de la especie. Ia única etapa a la cual no se da un trato completo, es la ninfal y es probable que tan poco se sabe respecto a los caracteres específicos de las especies tratadas que no fueron posibles descripciones completas y de una clave.

A continuación de la primera sección, la cual hace posible la identificación de los anofelinos de Venezuela y es una ayuda en el entrenamiento para su identificación en la mayoría de sus etapas, hay 3 secciones más reducidas. La primera de éstas define los tribus Megarhinini y Culicini en indica cómo se pueden distinguir de los Anophelini. La segunda es una discusión generalizada de los Anophelini, incluso una historia del estudio del tribu en Venezuela, distribución por estados de las especies venezolanas, el lugar que ocupa el tribu en el reino animaly las especies venezølanas dentro del tribu, y una parte dedicada a la clasificación, la nomenclatura, y la preparación y la aplicación de claves. La última sección trata de la anatomía interna y de las técnicas para la preparación, conservación y manejo de material viviente en el laboratorio.

Para cualquiera persona que se interese en identificar los *Anopheles* de la parte norte de Sur América, este libro debe ser de inestimable valor, y un estudiante quien domina la lengua castellana y desea especializarse para trabajos de laboratorio sobre estos *Anopheles,* hallará aquí un manual de estudio de inapreciable útilidad.—Translation of a review in English by Alan Stone, Bureau of Entomology and Plant Quarantine, U. S. Dept. of Agriculture, Washington, D. C.

A STUDY OF THE MIGRATORY HABITS OF SALT MARSH AND ANOPHELINE MOSQUITOES. Frank Brescia, Irwin D. Wilson, John Rowell, and Kenneth C. Hodges. Ann Ent. Soc. Am. 40(1):69–74, March, 1947.

Field use of the Insecticidal Aerosol Generator necessitated the study of migratory habits of the natural mosquito population in the test area. Daily migratory habits of *Aëdes sollicitans* and *A. taeniorhynchus* were determined by recording the number of mosquitoes landing per minute in various locations about an open

marsh land near Cocoa, Florida, at various times of the day over a 24-hour period. Counts were made over complete body of personnel after one minute of immobility in the following typical locations:

a. Laurel tree (good canopy) on road.

b. Palm tree (fair canopy) on road.

c. Middle of bridge (open conditions) over creek.

d. Laurel tree on marsh land but dry under tree.

e—Open pickle weed grounds on marsh land.

f—Mangrove tree (fair canopy) on marsh land with water under it.

Data derived from these counts indicated that:

a. Migration starts about dawn from open into shaded areas, in or about the open marshes, over 1-hour period with the minimum count at 8 A.M. and then increases in the hot sun of late afternoon.

b. Full migration starts about dusk from shaded into open marshes. It should be noted, however, that landing rates of over 100 were obtained during the night in jungle areas.

c. Dawn flights decrease population in the open marshes but not to zero. Fairly high counts obtained in open marshes under bright sunlight.

d. There was increased activity in open marshes before dawn and after dusk.

e. Evidence points to dawn and dusk migration.

f. For practical control, open marshes should be treated in the "predawn" and forested areas after dawn.

Migratory habits of *Anopheles quadrimaculatus* were studied in swamp areas near Decatur, Alabama. The data indicated that:

a. This species is completely inactive during periods of sunlight (resting periods).

b. It does not land or bite under sunlight conditions or when in flight near resting places.

c. Between sunrise and dark, this species rests in some dark, cool, damp place such as a tree hole, hollow log, or empty keg.

d. They leave their resting place during the hour following sunset.

Since the anopheline adults had practically a zero landing rate in the vicinity of their resting places over a 24-hour period, it was concluded that the adults in this particular location have acquired a definite preference for specific locales in which blood meals are daily sought.

It was concluded that control of the adult by aerosol treatment is feasible.

a. During the day while they are resting in tree holes.

b. At dusk when they are leaving tree holes.

c. In early morning when they are returning to tree holes.—LEO KARTMAN, University of Hawaii, Honolulu, T. H.

BIOLOGICAL CHARACTERISTICS OF LABORATORY-REARED *Aëdes atropalpus*. H. L. Trembley. J. Ec. Ent. 40(2):244–250. 1947.

Aëdes atropalpus, a species of rock-hole mosquito, has been added to that small group of mosquitoes which are autogenous. The females do not require blood meals, or, in fact, any food at all, in order to deposit viable eggs. A colony in which the females were fed only a sugar solution was reared in the laboratory for more than a year, and in its 26th generation continued with no apparent loss of vigor. A colony in which the females received only distilled water for several generations was thriving at the time the article went to press. A comparison of the life-cycles of individuals from the colony routinely offered blood and those denied blood showed no marked differences. The females of this species may be induced to bite when blood meals are offered, but subsequent oviposition results in comparatively few viable eggs. *Aëdes atropalpus* may mate in small spaces, has no seasonal period of comparative inactivity, and does not exhibit a decrease in the number of females with the increase in successive generations.—Author's abstract.

RESISTANCE OF MOSQUITO LARVAE AND PUPAE TO EXPERIMENTAL DROUGHT. George H. Bick and George H. Penn. Ann. Ent. Soc. Am. 40(1):82–86. 1947.

Random field observations in New Guinea showed that numerous late stage anopheline larvae were present in rain puddles which had evaporated to the damp mud stage and subsequently reflooded. Fourth instar larvae of *Anopheles punctulatus* survived approximately 120 hours on damp filter paper flooded for 30 minutes at 24 hour intervals.

Experiments are described which attempted to determine the effects of varying periods of drought and of periodic flooding on the larvae of *Anopheles walkeri*, which breeds in the shady, grassy margins of swamps and lakes; *Aëdes vexans*, which breeds in temporary pools; and *Wyeomyia smithii*, which finds its breeding water in pitcher plants.

Oversized filter paper was placed on the bottoms of petri dishes and sufficient water from the collection source was allowed to dampen the paper without showing a free liquid. Control dishes were flooded to a depth of ¼ inch. Experimental dishes were covered for maximum humidity, and control dishes were kept uncovered. Temperature ranged from 21° C. to 28° C.

Five 4th instar larvae of *Aëdes vexans* were added to each of 30 dishes and examined as follows: 15 each after 24 and 48 hours, and 30 each after 72, 96, 120, and 144 hours of continuous drought. Maximum survival time was 96 hours (17 per cent), while survival at 48 and 72 hours was not significantly different (13 per cent and 17 per cent). Third instar larvae of *A. vexans*, treated as above, gave a maximum survival time of 120 hours (20 per cent) when examined as follows: 30 larvae each after 24, 48, 72, 96, and 120 hours of continuous drought. One dish of 14 first and second instar larvae of

A. vexans was examined after 48 hours of drought. The maximum survival time was 48 hours (36 per cent). Although the control groups in these tests showed a decrease, there was always a significant difference between them and the experimentals.

Sixty 4th instar larvae of *Wyeomyia smithii* were set up 12 to a dish and examined as follows: 12 each after 48, 96, 144, and 192 hours of drought. Maximum survival time was 192 hours (83 per cent). The survival was irregular for the intermediate time groups. At 144 hours survival of the experimental group equalled the controls (48 per cent and 42 per cent) whereas at 192 hours the experimentals were 83 per cent as against 33 per cent of controls.

One hundred 4th instar larvae of *Anopheles walkeri* were examined on the following schedule: 10 after 24 hours and 15 each after 48, 72, 96, 120, and 144 hours of drought. After examination the dishes were kept flooded. Maximum survival time was 120 hours (27 per cent) and the mortality was limited up to 96 hours. The 27 per cent which survived the maximum time were injured and decreased to 7 per cent, 48 hours after return to flooded conditions.

Groups of larvae were then subjected to drought broken at 24-hour intervals by a 30 minute period of flooding. Fifteen 4th instar larvae of *Aëdes vexans,* 30 3rd instar *A. vexans,* 15 4th instar *Anopheles walkeri,* and 12 4th instar *Wyeomyia smithii* were used. This was of no obvious benefit to *A. vexans* and *W. smithii* larvae, but *A. walkeri* survived 120 hours longer than those in continuous drought.

One hundred twenty-five pupae of *Aëdes vexans* were set up as in the above series, the number in each dish depending on numbers available daily from cultures. Each dish was examined at 24-hour intervals and the number of imagines recorded. No control was used. No emergences were recorded after a maximum of 72 hours of standing, and imagines emerged from 94 per cent of the pupae.

These experiments indicated that larvicide programs should include depressions in the damp mud stage which may subsequently be flooded.—Leo Kartman, University of Hawaii, Honolulu, T. H.

RESISTANCE OF MOSQUITO LARVAE AND PUPAE TO EXPERIMENTAL DROUGHT. (Resistencia de Larvas y Ninfas de Mosquitos a la Sequía experimental.) George H. Bick y George H. Penn. Ann. Ent. Soc. Am. 40(1):82–86. 1947.

Observaciones hechas al azar en la Nueva Guinea demonstraron que numerosas larvas anofelinas en su última face de muda se encontraban en charcos de agua pluvial que se había evaporado hasta el estado de lodo húmedo y después vueltos a inundar. Cuatro larva de *Anopheles punctulatus* en estado de muda quedaron vivos después de aproximadamente 120 horas en papel de filtro húmedo inundado durante 30 minutos a intervalos de 24 horas.

Se hace una descripción de experiencias mediante las cuales se intentó averiguar los efectos de períodos variables de sequía y de la inundación periódica de larvas de *Anopheles walkeri,* los cuales se crian en los márgenes herbosos y sombríos de pantanos y lagunas; *Aedes vexans,* que se crian en charcos pasajeros, y *Wyeomyia smithii,* que busca el agua en que se cria en hojas ascidias.

Se colocó papel de filtro de tamaño un poco grande en el fondo de platillos "petri" y el agua suficiente, motado de las fuentes en las cuales se hicierón las capturas, para humedecer el papel sin dejar líquido libre visible. Los platillos de control se inundaron hasta una profundidad de .64 cm. Se taparon los platillos expermientales para conservar la humedad máxima y los platillos de control se dejaron descubiertos. La temperatura fluctuó entre 21° C y 28° C.

Cinco larvas de *Aedes vexans* en el 4o estado de muda fueron depositados en cada uno de 30 platillos y examinados como sigue; cada uno de 15, después de las 24 y las 48 horas, y cada uno de 30, después de las 72, 96, 120 y 144 horas de sequía continua. El tiempo máximo de sobrevivencia fué 96 horas (17%), aunque la sobrevivencia a las 48 y 72 horas no fué marcadamente diferente (13% y 17%). Larvas de *A. vexans* en la 3a muda, tratadas como queda indicado más arriba, dieron un tiempo máximo de sobrevivencia de 120 horas (20%) al ser examinados como sigue: cada una de 30 larvas después de las 24, 48, 72, 96 y 120 horas de sequía consecutiva. Un platillo de 14 larvas de *A. vexans* en la y 2a muda fué examinado después de 48 horas de sequía. El tiempo máximo de sobrevivencia fué 48 horas (36%). Aunque los grupos de control en estas experiencias indicaron una disminución, siempre se observó una diferencia significativa entre éllos y los experimentales.

Se colocaron 60 larvas de *Wyeomyia smithii* en su 4a muda en platillos de 12 cada uno y se examinaron como sigue: cada uno de 12 después de las 48, 96, 144 y 192 horas de sequía. El tiempo máximo de sobrevivencia fué 192 horas (83%). La sobrevivencia fué irregular en los grupos de tiempo intermedio. A las 144 horas, la sobrevivencia en el grupo experimental fué igual que en el de control (48% y 42%), mientras que a las 192 horas, la de los experimentales fué 83% comparado con 33% de los de control.

Fueron examinados 100 larvas de *Anopheles walkeri* en su 4a muda según el siguiente horario: 10 después de 24 horas y cada una de 15 después de 48, 72, 96, 120 y 144 horas de sequía. Después de examinados se conservó inundados los platillos. El tiempo máximo de sobrevivencia fué 120 horas (27%) y la mortalidad fué limitada hasta las 96 horas. El 27% que sobrevivieron el tiempo máximo habian sufrido

daños y disminuyeron al 7% dentro de las 48 horas después de volver al estado inundado.

Fueron expuestos grupos de larvas a una sequiá interrumpida a intervalos de 24 horas por un período de 30 minutos de inundación. Se usaron 15 larvas de *Aedes vexans* en 4a muda, 30 *A. vexans* en 3a muda, 12 *Anopheles walkeri* en 4a muda y 12 *Wyeomyia smithii* en 4a muda. Esto no benefició de modo evidente a las larvas de *A. vexans* y *W. smithii,* pero las de *A. walkeri* pudieron vivir 120 horas más que las expuestas a una sequiá continua.

Se acomodaron 125 ninfas de *Aedes vexans* como quedó indicado para la serie antes mencionada, regiéndose el número en cada platillo por el número disponible cada día proviniente de las culturas. Cada platillo fué examinado a intervalos de 24 horas y se hizo constar el número de imagos. No se usó control. No hubo constancia de emergencias después de un máximo de 72 horas de estancia, y emergieron imagos de 94% de las ninfas.

Estas experiencias conducen a la conclusion que los programas insecticidas deben abarcar depresiones en el suelo si contienen lodo en estado húmedo y si están expuestas a inundaciones posteriores.—Translation of an abstract by Leo Kartman.

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